

What is claimed is:

1. A microfluidic substrate assembly comprising:
a multi-layer laminated substrate defining at least one fluid inlet port and at least one
microscale fluid flow channel within the multi-layer substrate in fluid communication with the inlet
port for transport of fluid; and
at least one operative component mounted aboard the multi-layer laminated substrate in
communication with the microscale fluid flow channel.
2. The microfluidic substrate assembly of claim 1 in which the operative component mounted
aboard the multi-layer laminated substrate is in fluid communication with the at least one microscale
fluid flow channel.
3. The microfluidic substrate assembly of claim 2 in which the operative component mounted
aboard the multi-layer laminated substrate is operative as a fluid reservoir.
4. The microfluidic substrate assembly of claim 1 in which the operative component mounted
aboard the multi-layer laminated substrate is operative as a light sensor across a microscale fluid
flow channel within the multi-layer substrate.
5. The microfluidic substrate assembly of claim 1 in which the operative component mounted
aboard the multi-layer laminated substrate is operative as an ultrasonic actuator or transducer across
a microscale fluid flow channel within the multi-layer substrate.
6. The microfluidic substrate assembly of claim 1 in which the operative component mounted
aboard the multi-layer laminated substrate is operative to generate fluid pressure in a microchannel
of the substrate.
7. The microfluidic substrate assembly of claim 6 in which the operative component mounted
aboard the multi-layer laminated substrate is a thermal actuator.

8. The microfluidic substrate assembly of claim 6 in which the operative component is a micromachined pump, diaphragm pump, syringe pump or volume occlusion pump.
9. The microfluidic substrate assembly of claim 1 in which the operative component mounted aboard the multi-layer laminated substrate is operative to induce flow in a microchannel of the multi-layer laminated substrate endosmotically or by electrochemical evolution of gases.
10. The microfluidic substrate assembly of claim 1 in which the multi-layer laminated substrate further comprises at least one fluid outlet port in fluid communication with the fluid inlet port within the multi-layer substrate.
11. The microfluidic substrate assembly of claim 1 in which the operative component mounted aboard the multi-layer laminated substrate is at least one electronic memory unit mounted to the substrate assembly and operatively connected to the microfluidic substrate assembly.
12. The microfluidic substrate assembly of claim 11 further comprising at least one operative component mounted aboard the multi-layer laminated substrate in communication with the microscale fluid flow channel and operative to generate an electronic signal corresponding to a detected characteristic of fluid in the microscale fluid flow channel, wherein the at least one electronic memory unit is connected to the operative component to receive and record the electronic signal.
13. A microfluidic substrate assembly comprising a generally planar multi-layer laminated substrate defining
 - at least one fluid inlet port and at least one microscale fluid flow channel at each of more than one level within the multi-layer laminated substrate for transport of fluid, and
 - at least one microchannel via extending between levels within the multi-layer laminated substrate for fluid communication between microscale fluid flow channels of different levels.
14. The microfluidic substrate assembly of claim 13 in which the at least one microchannel has a configuration which is straight, curvo-linear, serpentine or spiral.

15. A microfluidic substrate assembly comprising a multi-layer laminated substrate defining at least one fluid inlet port and at least one microscale fluid flow channel in fluid communication with the inlet port for transport of fluid, wherein at least one layer of the multi-layer laminated substrate is formed of plastic and the substrate assembly is operative and fluid tight at fluid pressure in the microscale fluid flow channel in excess of about 100 psi.
16. The microfluidic substrate assembly of claim 15 in which the multi-layer laminated substrate is operative and fluid tight at fluid pressure in the microscale fluid flow channel in excess of about 1000 psi.
17. The microfluidic substrate assembly of claim 15 in which the multi-layer laminated substrate further comprises rigid plates sandwiching the plastic layer between them.
18. The microfluidic substrate assembly of claim 17 in which multiple layers of the multi-layer laminated substrate are formed of plastic and are welded one to another, the rigid plates sandwiching the multiple plastic layer between them.
19. The microfluidic substrate assembly of claim 18 in which the multiple plastic layers of the multi-layer laminated substrate are selectively welded one to another to form a fluid-tight seal along a channel within the substrate.
20. A microfluidic substrate assembly comprising a multi-layer laminated substrate defining at least one fluid inlet port and at least one microscale fluid flow channel within the multi-layer substrate in fluid communication with the inlet port for transport of fluid, in which at least one layer of the multi-layer laminated substrate is formed of PEEK.
21. The microfluidic substrate assembly of claim 20 in which the at least one PEEK layer is formed of amorphous PEEK.
22. The microfluidic substrate assembly of claim 20 in which the at least one PEEK layer is formed of crystalline PEEK.

23. The microfluidic substrate assembly of claim 20 in which the at least one PEEK layer comprises IR absorbing species in concentration sufficient for IR welding of the PEEK layer.
24. The microfluidic substrate assembly of claim 23 in which the IR absorbing species is distributed substantially homogeneously throughout the PEEK layer.
25. The microfluidic substrate assembly of claim 23 in which the IR absorbing species is disposed on the surface of the PEEK layer.
26. The microfluidic substrate assembly of claim 25 in which the IR absorbing species is selected from dyes, zinc oxide, silicon oxide and metal species.
27. A microfluidic substrate assembly comprising a multi-layer laminated substrate defining at least one fluid inlet port and at least one microscale fluid flow channel within the multi-layer substrate in fluid communication with the inlet port for transport of fluid, wherein at least first and second layers of the multi-layer laminated substrate are selectively welded to each other to form a fluid-tight seal at least along a channel within the multi-layer laminated substrate.
28. The microfluidic substrate assembly of claim 27 in which the multi-layer laminated substrate further comprises at least one environmentally sensitive structure intolerant to a transition glass temperature of the first and second layers.
29. The microfluidic substrate assembly of claim 28 in which the environmentally sensitive structure is an architectural feature of the microscale fluid flow channel, a mechanical sensor, a mechanical device, an electrical sensor, an electrical device, a fluid, chromatography reagents and any combination of them.
30. The microfluidic substrate assembly of claim 28 in which the environmentally sensitive structure is disposed in the microscale fluid flow channel.

31. A method of producing a multi-layer laminated substrate, comprising the steps of:
- forming a surface-to-surface interface by aligning a surface of a first substrate component against a surface of a second substrate component to form a substrate sub-assembly having an internal fluid channel at the interface; and
 - exposing the sub-assembly to radiation to heat only one or more selected portions of the interface to a temperature sufficient to weld the substrate components together, to form a fluid-tight seal between the substrate components at the interface along the fluid channel.
32. The method of claim 31 further comprising the steps of coating at least a selected area of the surface of the first substrate component with a radiation absorptive material prior to forming the surface-to-surface interface.
33. The method of claim 32 in which the absorptive material is coated onto only one or more selected portions of the surface of the first substrate component and the sub-assembly is exposed non-selectively to IR radiation.
34. The method of claim 32 in which the absorptive material is coated onto the entire surface of the first substrate component and only one or more selected portions of the interface are exposed to IR radiation.
35. The method of claim 34 in which the sub-assembly is exposed to radiation through a mask having a configuration corresponding to the one or more selected portions of the interface.